THE BIOSPHERE: A DECADAL VISION

The biosphere is the entire living part of the planet,

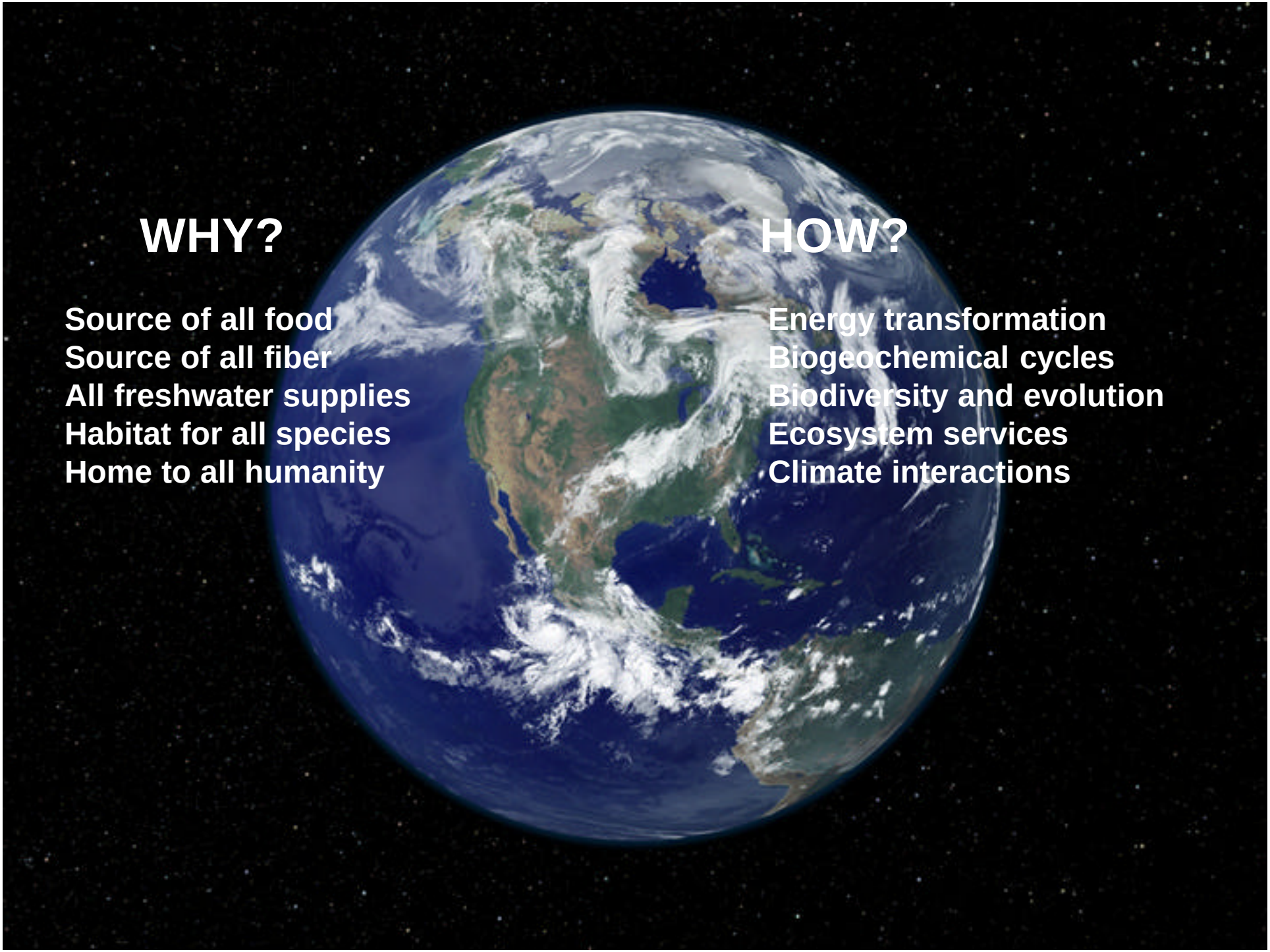
The blue ocean,

The coastal zone and

The terrestrial ecosystems

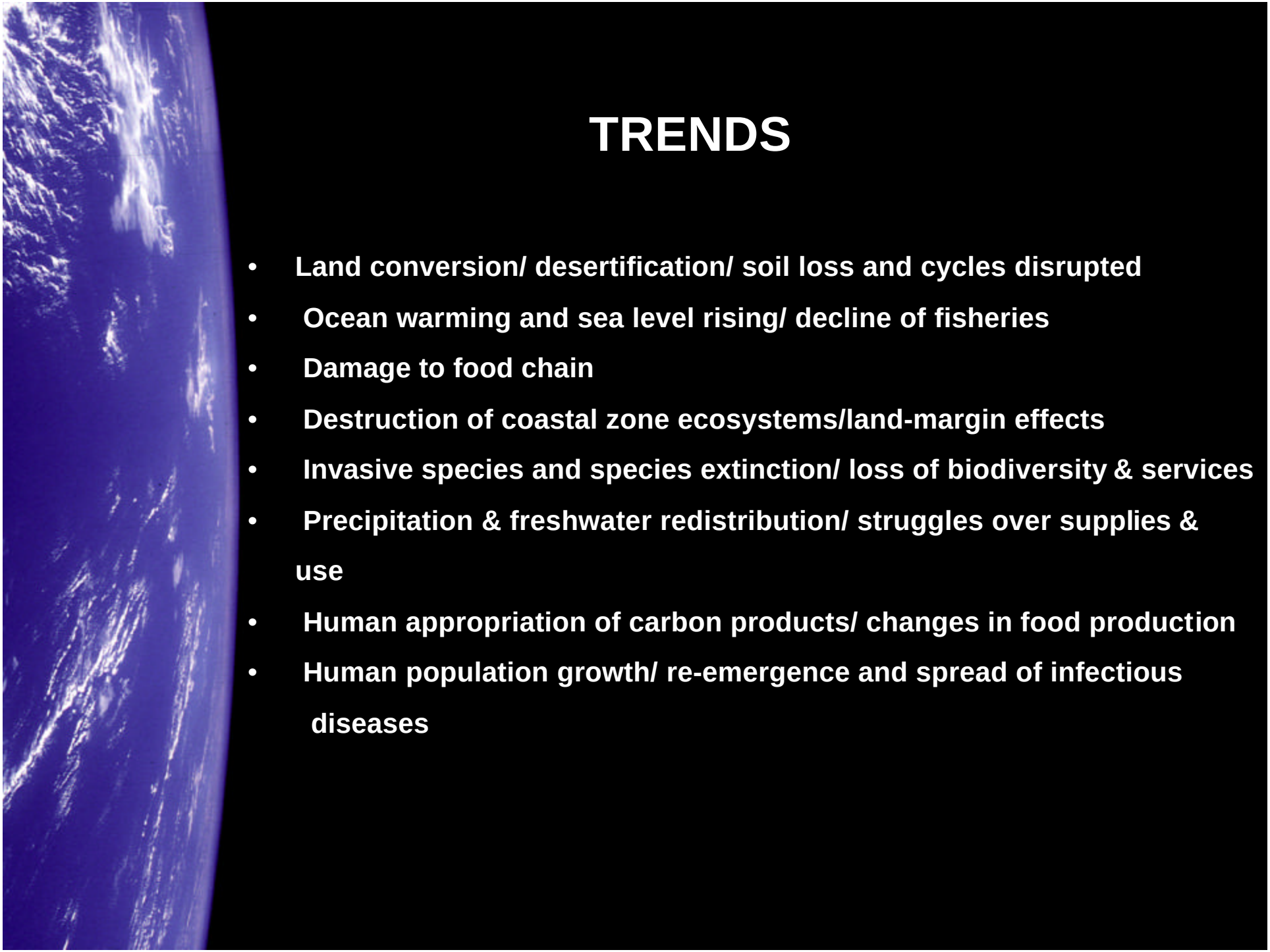
including all humanity

Freshwater: the usable 1% of the Earth's total water volume.


WHY?
Source of all food
Source of all fiber
All freshwater supplies
Habitat for all species
Home to all humanity
HOW?
Energy transformation
Biogeochemical cycles
Biodiversity and evolution
Ecosystem services
Climate interactions

PRIORITIES

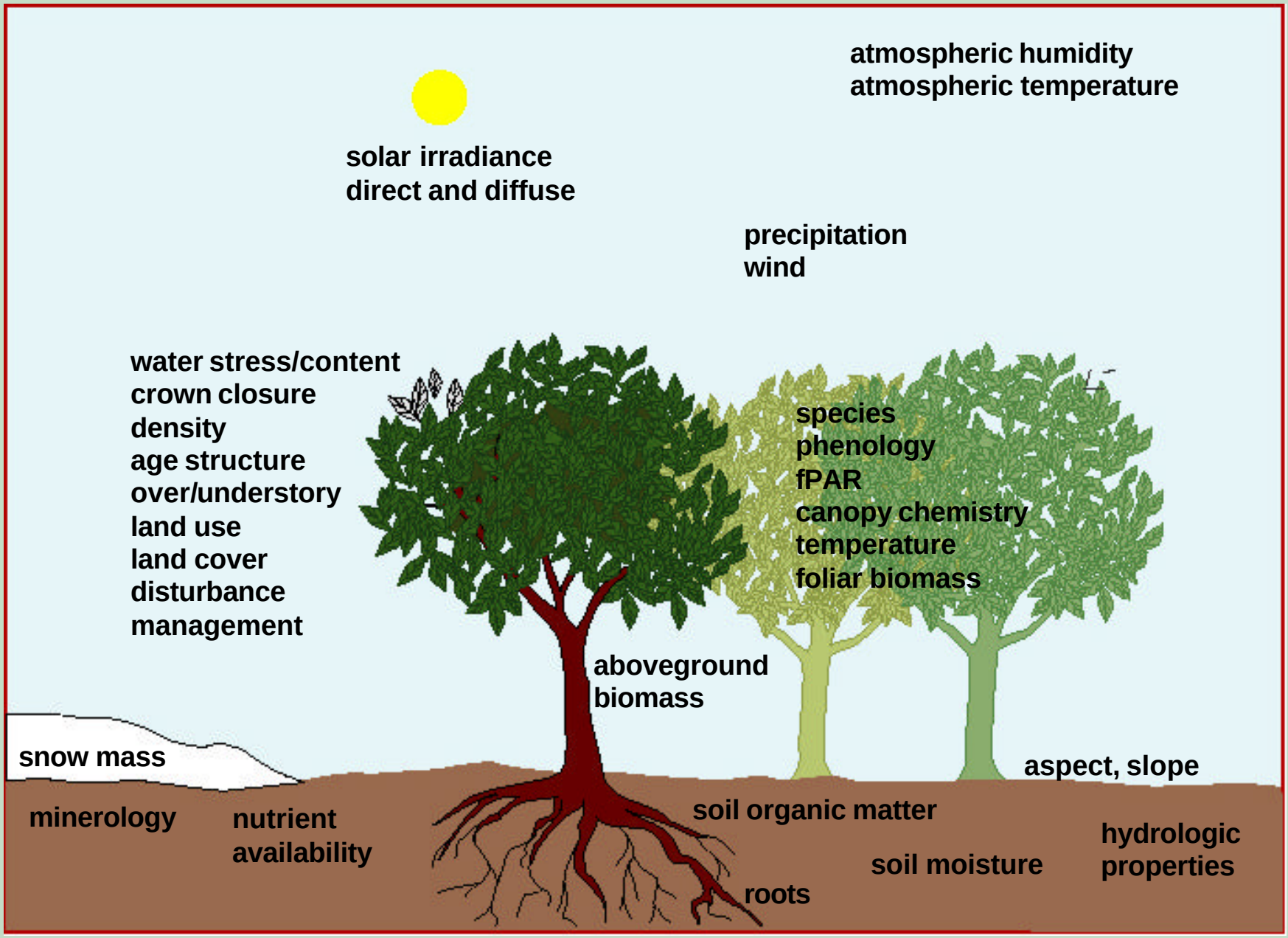
SPACE	NON-SPACE
Climate change	**IGBP**
Solid Earth/natural hazards	**Biospheric balance**
Lack of balance	**Sustainability**



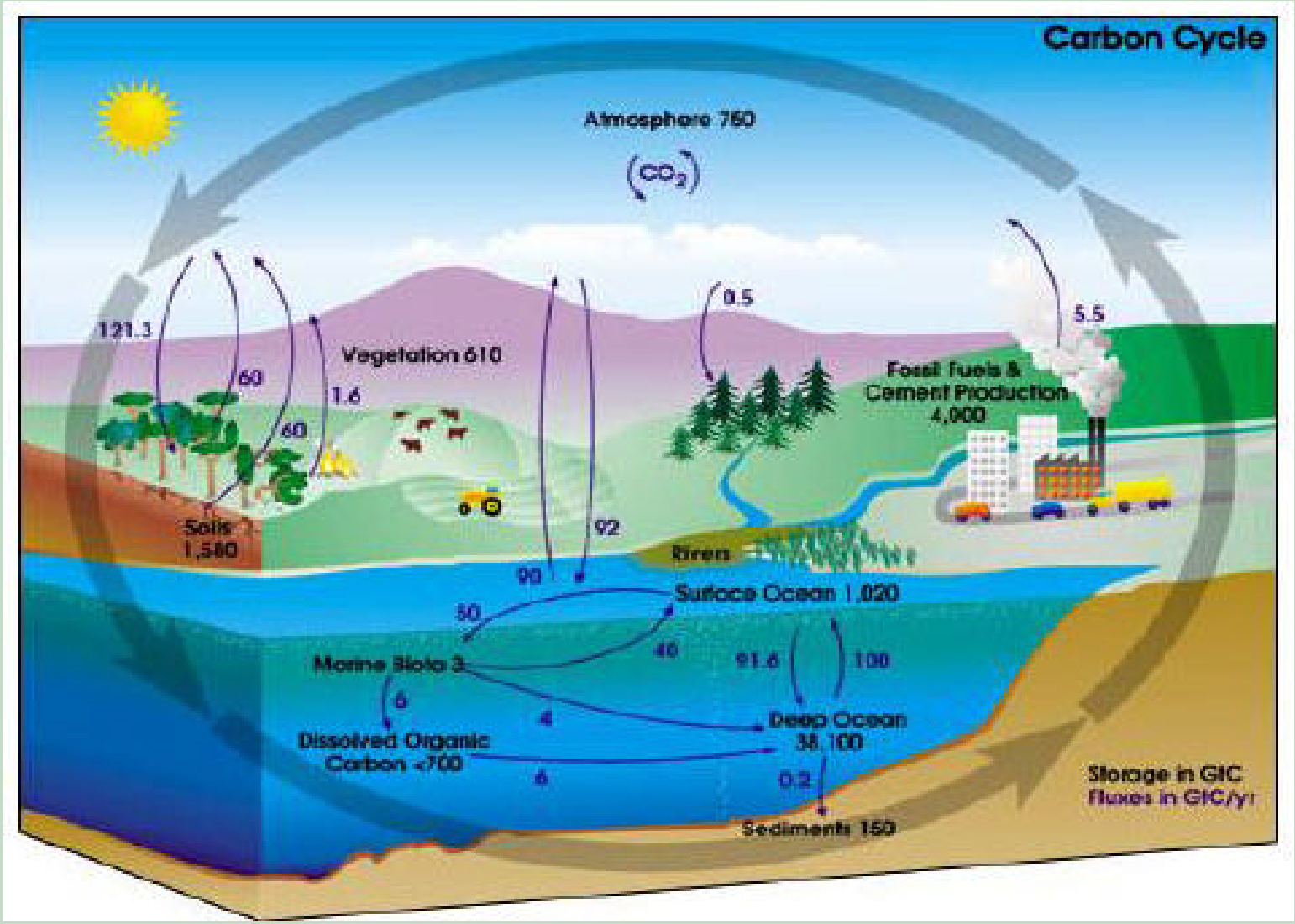
TRENDS

- Land conversion/ desertification/ soil loss and cycles disrupted
- Ocean warming and sea level rising/ decline of fisheries
- Damage to food chain
- Destruction of coastal zone ecosystems/land-margin effects
- Invasive species and species extinction/ loss of biodiversity & services
- Precipitation & freshwater redistribution/ struggles over supplies & use
- Human appropriation of carbon products/ changes in food production
- Human population growth/ re-emergence and spread of infectious diseases

Remotely sensed variables



WHERE DO WE STAND OVER THE NEXT DECADE ?



WHAT SHOULD WE AIM TO ACHIEVE ?

- **Climate-biosphere interactions**

Goal: to complete our ability to predict climate change, biospheric influences and biospheric responses.

- **Is this enough ?**

No. There are many urgent issues in the biosphere and in freshwater systems for which climate change is not primary.

Biospheric and Freshwater Variables

Measurements	Frequency	Spatial Resolution	Precision/ Accuracy	Comments
Ocean/CZ mixed layer depth, wind fields, salinity	Weekly	10 km	10%	Active sensors
Ocean evaporation rate	Daily	10 km	5%	To 1 m depth
Stream flow	Daily	NA	10%	
Precipitation	Hourly	50 km? in 10 yrs<25 km		
Aerosol distribution & absorption properties	Hourly		10%	
Nutrient fields (N, SI, Fe), aerosol deposition, functional groups	Weekly	10 km	30%	Passive sensors
Coastal zone: Colored dissolved organic matter, chlorophyll and other pigments; Functional groups; Bathymetry and bottom reflectance; Nutrient concentration (N, Si, Fe, P)	Daily-Weekly	100 m	10%	Hyperspectral (350-900 nm), also radiometry
Coastal zone physiological state (fluorescence)	Daily	100 m	20%	Space-based passive fluorometer (Fraunhofer) or excitement/emission fluorometer
Terrestrial ecosystem phenological state (leaf out, senescence)	Diurnally	1 km	<one day	Libration point (L1) vis-IR sensors
Biochemical composition of plant canopies (N, lignin, pigments, chlorophylls, etc.) Responses to multiple stressors (long-term observations)	Weekly	100-200 m	25%	Hyperspectral and/or special-purpose spectroscopic
Fire properties (energy release rates, rate of spread, gas/aerosol loading, soil heating)	Daily	100 m	20%	Multispectral thermal with broad radiometric sensitivity
Standing vegetation biomass over time	Monthly-Annual	100 m	10%	LIDAR in repeat missions
Vegetation structure, successional state, primary & secondary vegetation conditions	Monthly	100 m	20%	Hyperspatial multi-spectral
Soil moisture	Daily	100 m		
Soil properties (carbon stocks, nutrient availability, hydrologic properties)	Monthly to Weekly			High spectral resolution
Bathymetry	Once	100 m	10%	
Reservoir and Aquifer Impoundment	Monthly	size of storage basin	0.1 mm/yr	Sea-level rise equivalent

Modeling Requirements for the Future

- Coupled ecophysiological & community models
  - succession trajectories in chronically disturbed landscapes
- Complete the models of the biosphere boundary to climate system
  - with biotic, abiotic & human controls
- Develop fully interactive biosphere models to assess and predict biosphere response to climate and solid Earth process change
- Improve bio-optical and radiation transport models, especially Case 2 waters and terrestrial /CZ radiation environments
- Models of long range transport of bio-material via aeolian, hydrologic & human means
- Models of nutrient redistribution and hypersaline flows
- Retrospective models of processes to longer time spans (100's to 1000's of years)

Prediction and Forecasting